

EXAMINING THE DRIFT SHADOW IN NATURE

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RESEARCH OBJECTIVES

The drift shadow is a region in the unsaturated zone beneath an underground opening (such as a cave or mined tunnel) that is partially sheltered from downward-percolating water, because the capillarity is not strong enough to draw water into the rock immediately below the drift. Modeling studies of the drift shadow suggest that transport in this region is controlled by diffusive rather than by advective processes. The drift shadow has not yet been observed in nature. Our research objective is to demonstrate the presence (or absence) of the drift shadow at a field location and compare our measurements to predictions.

APPROACH

To identify a drift shadow, we must find an appropriate field site where a drift shadow might be observed, obtain core samples from locations at different depths around the opening, and make measurements of water potential and water content that would indicate the presence or absence of the drift shadow. In addition, we would like to impose a water flux over a drift and observe its flow behavior and possible drift shadow formation. We must also compare our field results with modeling results of a detailed site-specific model to gain confidence in modeling studies of the drift shadow.

ACCOMPLISHMENTS

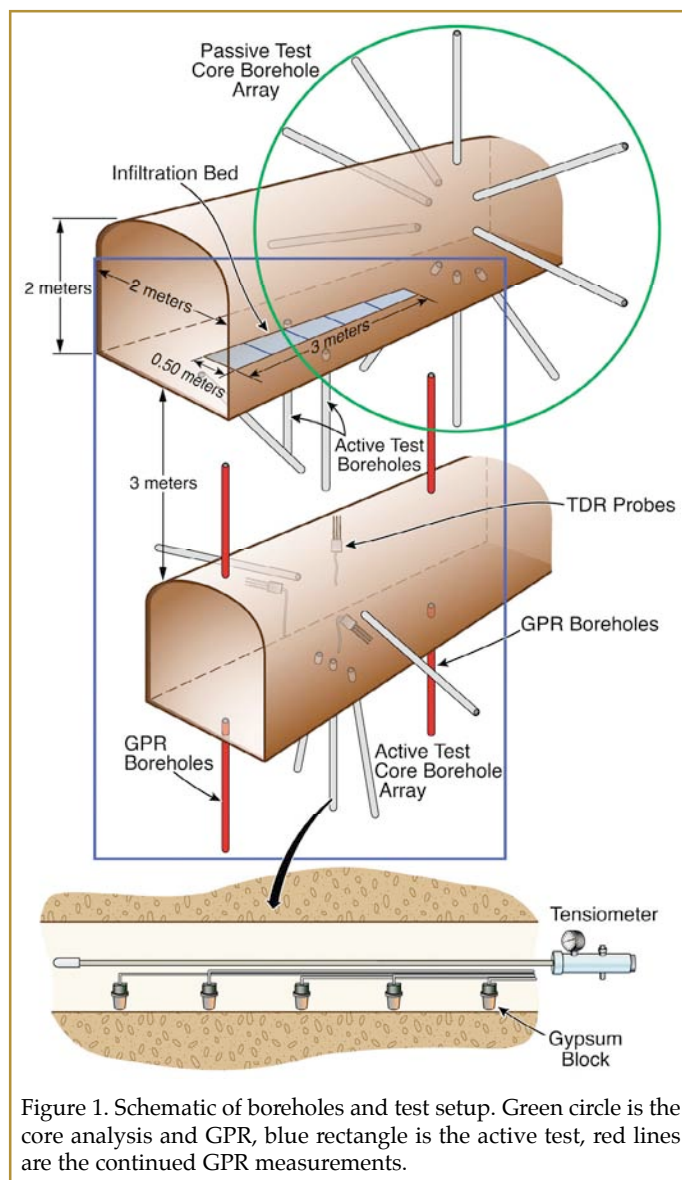
We have performed extensive modeling to understand the theoretical definition and extent of the drift shadow for various sets of conditions. Based on our modeling, we selected and are investigating the presence of the drift shadow in the East Bay Regional Parks District Hazel-Atlas Mine, a former sand mine in Northern California that is now operated as a museum. Our study location, not currently in the museum, contains a drift-over-drift configuration. We have retrieved core from core holes fanning the two drifts, x-ray-scanned them looking for density changes, and measured gravimetric moisture content of subsamples of the core. We have performed ground-penetrating radar studies using the core holes to look for saturation changes indicating the presence of a drift shadow and are constructing an active test to impose water flow around the lower drift.

SIGNIFICANCE OF FINDINGS

Demonstrating the presence of a drift shadow will provide another line of evidence to build confidence in the theory of flow and transport in unsaturated media and its numerical extension. In addition, it will allow the consideration of significantly reduced transport from waste emplacement drifts at the proposed high-level nuclear waste repository at Yucca Mountain, Nevada, in which waste packages are expected to be placed in near-horizontal drifts in the unsaturated zone.

RELATED PUBLICATIONS

Ghezzehei, T.A., T.J. Kneafsey, and G.W. Su, Correspondence of the Gardner and van Genuchten relative permeability function parameters. *Water Resources Research* (in press), 2007.
Houseworth, J.E., S.A. Finsterle, and G.S. Bodvarsson, Flow and transport in the drift shadow in a dual-continuum model. *Journal of Contaminant Hydrology*, 62–63: 133–156, 2003.



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